cultural Society in richly-manured land, and the produce proved abundant, yielding, the first year, 600 tubers as large as pigeons' eggs. The constitutional effects of the abnormal production of tubers which high farming occasions have been often noticed. On this point Mr. Baker says: "Any plant brought to the tuber-bearing state is in a disorganised, unhealthy condition, a fitting subject for the attacks of fungus and aphides."

It frequently happens, moreover, that the cultivated potato loses its power of producing flower and of reproducing itself by means of seed. The illustrious horticulturist, Thomas Andrew Knight, discovered the relationship of tuber to fruit, and demonstrated with great clearness the principle that, in proportion as plants or animals waste in one direction, they must economise in another. Knowing the difficulties that lay in the path, Lord Cathcart intrusted some tubers of *S. Maglia* from the coast of Chili to those eminent potato-breeders, whose collection of varieties Mr. Baker refers to as the largest in the world, Messrs. Sutton and Sons of Reading. After very careful treatment of the tubers, which were about the size of walnuts, the young plants were committed to the open ground, where, making our story as short as possible, they grew vigorously and produced numerous blossoms having white corollas, which are characteristic of wild potatoes, the corollas of cultivated breeds being purple and lilac. But whatever the seed-bearing capabilities of *S. Maglia* may be at Valparaiso and in the Chonos Archipelago, when growing in a state of nature, it did not produce a single seed in Messrs. Suttons' trial-grounds, except in the case of some blossoms which were hybridised. It is needless to describe the particular means by which this delicate operation was effected. It happens, however, that the manipulator was the same veteran breeder who had grown despondent about potatoes until this new departure had been achieved. Last winter he had reached the end of his tether. Since then he has hybridised *Solanum Maglia*, and is anticipating the conquest of new potato worlds in his old age.

The crop at Reading this first year is good, and the tubers are as large as those of ordinary potatoes. The foliage is luxuriant, growing as high as a common table. Certain other sorts have shown no capacity for "improvement." *S. Jamesii*, for example, grows at Reading only eight or ten inches high, and would scarcely be recognised as a potato except by a botanist. *S. Commersoni*, known by the synonym *Ohroudi*, from the name of a French naval surgeon who brought it to Brest from Goritti Island, at the mouth of the Rio de la Plata, was obtained last spring by Messrs. Sutton from M. Blanchard of the Gardens of the Naval Hospital at Brest. Messrs Sutton have wisely acted throughout these trials under scientific advice, and *S. Commersoni* had been named by Mr. Baker as one of the few species which are known at present to have shown a capability of "improvement." Unfortunately it resisted all the attempts that were made last summer at Reading to hybridise it with the cultivated sorts. We may hope, however, to become possessed of this and other hybrids before breeders have travelled far on the road which has now been opened to them. Previous attempts to overcome the potato disease had been mainly directed to the doctoring of the soil, or plant, and to direct attacks upon the disease. Every gardener and farmer may now welcome the birth, so to speak, of a hybrid, which, we may hope, will enable the potato plant to resist the attack of parasites, and especially those of the devastating fungus *Peronospora infestans*. H. E.

ON THE EVOLUTION OF THE BLOOD-VESSELS OF THE TEST IN THE TUNICATA

IT is well known that the test or outer tunic in most Simple Ascidians is penetrated by a system of tubes containing blood. These "vessels" were shown in 1872 by Oskar Hertwig [1] to be developed as ectodermal evaginations containing prolongations from one of the blood-sinuses of the underlying mantle. Each vessel is divided longitudinally into two distinct tubes by a septum of connective tissue, and after ramifying through the test may be found to terminate, generally close to the outer surface, in one or more rounded enlargements or bulbs which are usually known as the "terminal knobs" (Fig. 5, B). The two blood-tubes join in the terminal knob where the septum ends, and this allows the blood which flows outwards through the one tube to turn in the bulb and flow back

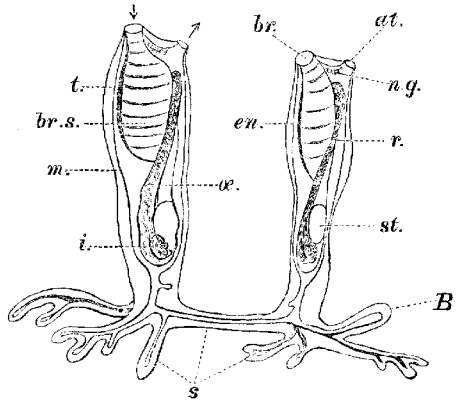

FIG. 1.—*Clavelina lepadiformis*. Enlarged from a specimen dredged off Dartmouth. *br.*, branchial aperture; *at.*, atrial aperture; *br.s.*, branchial sac; *t.*, test; *m.*, mantle; *œ.*, œsophagus; *st.*, stomach; *i.*, intestine; *r.*, rectum; *en.*, endostyle; *n.g.*, nerve ganglion; *s.*, stolon; B, part of the stolon becoming enlarged to form a bud.

along the other tube. Thus temporarily the one tube acts as an artery and the other as a vein, but of course they exchange functions at each reversal of the heart's action.

This system is usually regarded as being merely the blood-supply to the test; but Lacaze-Duthiers [2] has pointed out that the hair-like projections from the test to which sand-grains adhere in most Molgulidæ, are merely special developments of the terminations of the vessels, and I have suggested [3] that they are also homologous with the vessels in the stolon of the Clavelinidæ from which buds are produced (Fig. 1).

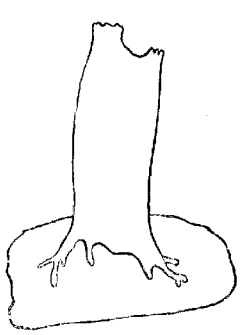

FIG. 2.

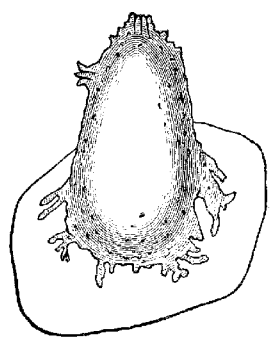

FIG. 3.

FIG. 2.—*Ciona intestinalis* from Lamlash Bay, Arran. Natural size.
FIG. 3.—*Ascidia aspersa* from Lamlash Bay, Arran. Natural size.

The extent to which this blood-system of the test is developed varies greatly in the different species of Simple Ascidians. In some, such as *Ascidia plebeia* and *Corella parallelogramma* (Fig. 4), it is very rudimentary, if indeed it can be said to be present; while in others, such as *Ascidia mentula*, *Ascidia meridionalis*, and *Ascidia*

[1] "Untersuchungen über den Bau und die Entwickelung des Cellulose-Mantels der Tunicaten," *Jenaische Zeitschrift*, Bd. vii. p. 46.
[2] *Archives de Zoologie expérimentale et générale*, t. iii. p. 314, 1874; and *Comptes Rendus*, t. lxxx. p. 600, 1875.
[3] *Proc. Roy. Soc. Edin.* 1879-80, p. 719.

reptans, the test is penetrated in all directions by a well-developed system of tubes with large and numerous terminal bulbs. A series of Simple Ascidians could be formed showing all conditions between these two extremes, and also exhibiting very varied arrangements in regard to the disposal of the vessels in the test, their modes of branching, and the relative numbers and sizes of the terminal bulbs. But perhaps the most interesting modifications of all are those met with in some of the members of the remarkable deep-sea genus *Culeolus*. There we find a great development of the vessels and their enlargements just on the surface of the test, and separated from the surrounding medium by a very thin layer of tissue. When describing this system in 1882,[1] I suggested that in these species it might act as an accessory organ of respiration, and I have lately shown [2] that an investigation into the condition of the corresponding system of vessels in some of the Compound Ascidians supports this idea, the chief arguments in favour of which are :—

(1) The disposition of the tubes and cavities in the different regions and layers of the test, and the anatomical characters of the system.

(2) The relation which exists in many groups of Ascidians between the branchial sac (the chief organ of respiration) and the system under discussion,—where the branchial sac is large and highly developed, the vessels in the test are few and small ; but where the branchial sac is small, simple, and apparently inefficient, the vessels in the test are numerous, of large size, and disposed in such

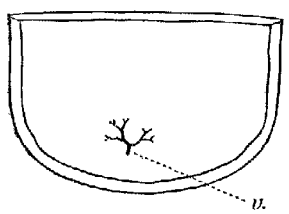

FIG. 4.—*Corella parallelogramma*. The posterior part of the left side of the test of a specimen from Loch Fyne. Twice the natural size. *v.*, the system of vessels.

a manner as to suggest that they are concerned in the aëration of the blood.

It is obvious that it would be advantageous to an Ascidian if its test could act even to a slight degree as an accessory respiratory organ, by allowing the blood circulating in its superficial layers to be brought into such close relation with the external medium as to render possible a certain amount of oxidation. And consequently it is easy to imagine the process of evolution of such a complicated system as we find in *Culeolus murrayi* from a few simple vessels like those in the test of *Corella parallelogramma* (Fig. 4). But it is probable that the common ancestor of Simple and Compound Ascidians had no blood-spaces in its test. There are none in the "Haus" of the Appendicularidæ ; and in *Clavelina*, which may be regarded as nearer to the first Simple Ascidian than any other form known, there are no vessels in the test except those of the stolon. Some structure must therefore be looked for from which the first respiratory blood-system of the test may have been evolved, and such a structure is to be found, I believe, in the gemmiparous stolon of the Clavelinidæ.

Clavelina (Fig. 1), which from other independent evidence I regard as the most primitive form of Simple Ascidian known to science, is one of the so-called "Social" Ascidians in which the members of the colony are united by a creeping stolon containing "vessels" (that is a prolongation of the ectoderm and the mantle, and a blood-tube) which place the circulatory systems of the various members in communication, and from the ends of which, in prolongations of the test (as at B, Fig. 1), new members are produced by gemmation. It is possible that this system may act in some slight degree as a respiratory organ, but its chief function, and probably its only one, is the asexual production of new individuals.

The ancestors of the remaining Simple Ascidians diverged from the ancestors of the Clavelinidæ, and lost the power of reproducing by gemmation, but in many of the least modified of the Ascidiidæ we still find processes from the posterior end of the test which contain vessels, and so closely resemble the stolon of *Clavelina* in all particulars that there can be no doubt that they are persistent rudiments of that structure.

In *Ciona*, which is certainly one of the most primitive of the Ascidiidæ, vessels are only present in the posterior part of the test, and here we frequently find them drawn out into long processes of the test, which have the greatest possible resemblance to stolons (Fig. 2), and are doubtless their homologues, although they no longer function as bud-producing organs. They are useful as adhering organs, and they have probably to a slight extent commenced to perform a respiratory function.

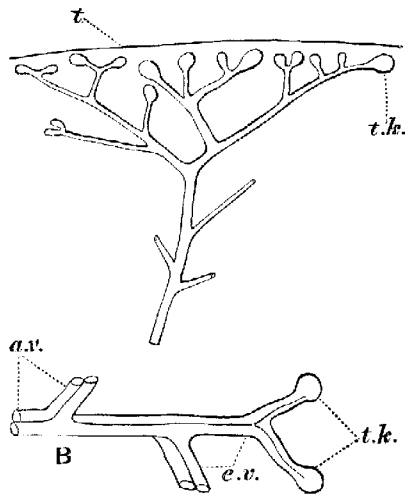

FIG. 5.—Vessels in the surface layer of the test of *Ascidia mammillata* as seen in a section magnified about 40 diameters. B, small part of the system more highly magnified ; *a.v.*, afferent vessel ; *e.v.*, efferent vessel ; *t.k.*, terminal knob ; *t.*, surface of the test.

I imagine then the first stages in the evolution of the "respiratory" vessels to be as follows :—As the ancestors [1] of the Ascidiidæ lost the power of reproducing by gemmation, the vascular stolons became rudimentary, until they were useful merely as adhering organs. For some time they would only be produced at the posterior end of the test (their original position in the Clavelinidæ), but in course of time they would extend further forwards along the left side of the body (the side upon which most Simple Ascidians lie) so as to anchor the animal more securely, and we even find them occasionally in this condition in *Ciona intestinalis* and in *Ascidia aspersa* (Fig. 3).

They would then probably (in some not very remote ancestor of *Ciona*) begin, while still acting as adhering organs, to be of some slight use in respiration, and would, consequently, by the action of natural selection, be evolved gradually into a larger system of vessels extending over a wider area of the test. And here might be shown a series of the Ascidiidæ passing from *Ciona* (Fig. 2) through *Corella* (Fig. 4), and *Ascidia plebeia*, in which the system is still very feebly developed and confined to the posterior half of the left side of the

[1] "Zoological Reports of the *Challenger* Expedition," Part xvii. pp. 90 and 279.

[2] *Proc. Lit. and Phil. Soc.*, Liverpool, session 1884-85.

[1] See phylogenetic table in "*Challenger* Reports," part xvii. p. 286.

test, by gradual stages to *Ascidia mammillata* (Fig. 5), where the vessels are numerous all over the test, branch freely in its outer layer, and terminate close to the surface in large ovate bulbs, which are usually found filled with blood-corpuscles.

The only part of this history which presents any difficulty is the passage from the Clavelinid to the Cionid arrangement, from the gemmiparous stolon to the first traces of a respiratory system of vessels. This can, I believe, be most satisfactorily explained by assuming that the rudimentary stolons after they had lost their primary function became useful as adhering organs (Figs. 2 and 3), and consequently were retained or possibly increased by the action of natural selection, until their respiratory function became established.

I hope to work out the modifications of the system throughout the various groups of Ascidians in detail, and the results will probably be given in Part II. of the Report on the *Challenger* Tunicata.

W. A. HERDMAN

NOTES

THE Council of the Royal Astronomical Society have awarded their gold medal to Dr. W. Huggins for his researches on the motions of stars in the line of sight and on the photographic spectra of stars and comets. The presentation takes place at the annual meeting next month. This is the second time that Dr. Huggins has received the medal, he having, in 1867, in conjunction with the late Prof. Miller, received it for his researches in astronomical physics.

THE will of Mr. George Bentham, who died in September last, has been proved by Sir Joseph Dalton Hooker and the Right Hon. Sir Nathaniel Lindley, the executors, the value of the personal estate amounting to over 23,000*l.* The testator bequeaths, among other sums, 1000*l.* each to the Linnean Society of London and the Royal Society Scientific Relief Fund. The residue of his real and personal estate is to be held upon trust to apply the same in preparing and publishing botanical works, or in the purchase of books or specimens for the botanical establishment at Kew; or in such other manner as his trustees may consider best for the promotion of botanical science.

AT the meeting of the Colonial Institute on Tuesday, Gen. Sir Henry Lefroy read a paper on the meeting of the British Association in Canada. Sir Lyon Playfair, M.P., referred to the visit of the British Association as marking a point in the advance of civilisation. Canada's position of having federated, not under the pressure of war, but in a time of profound peace, was unique in the history of the world. The science of Great Britain belonged to the Empire, and it was right that Canada should be the first to try to federate the science of the United Kingdom, and distribute it over the Empire. What Canada wanted was not pure science, but applied science, to bind together her vast territory by railways. But knowing that applied science did not come except pure science preceded it, Canada had had the forethought and wisdom to welcome that pure science to the Dominion. Sir Lyon gave a humorous account of an adventure he had in a wild part of Ottawa with a Scotch mining manager. It turned out that the manager, when in Scotland, had attended the Mechanics' Institute at Glasgow, and afterwards the evening classes at the Andersonian Institution, obtaining a knowledge of chemistry and mineralogy, which had stood him in good stead on emigrating to Canada. From his compatriot he (Sir Lyon) heard of many other Scots of a like type, all of whom had got on well, from the scientific education they had acquired at similar institutions. For such men he did not know any better country than Canada to find openings for getting on in the world. Prof. G. T. Bonney spoke at some length of the interesting geological formation of Canada, and said he believed that the district north of the St. Lawrence was rich in valuable minerals, and that exploring parties for their discovery should be organised to supplement the systematic geological survey which was being slowly conducted. He condemned the wasteful treatment of the forests that was going on in some of the parts he had visited, and suggested that it was a matter which should engage the attention of the Dominion Government.

ON Tuesday evening Sir Frederick Bramwell gave an address at the Institution of Civil Engineers on his assuming the chair for the first time since his election as president. Sir Frederick's subject was suggested to him by the forthcoming Exhibition of Inventions, his address consisting mainly of a review of some of the most remarkable recent inventions in the application of science to engineering. Sir Frederick has apparently given up hope of our being able to put the tides to any practical use, and hints that Khartoum might have been relieved long ago had our aëronauts been as inventive, or our War Department as enterprising, as those of France.

M. COCHERY, the French Minister of Posts and Telegraphs, was present, on January 2, at Rouen to witness some interesting experiments in telephoning to a great distance. The object was to test the results of the application between Rouen and Havre, a distance of 90 kilometres, of M. Van Rysselberghe's system of instantaneous transmission. The experiment was perfectly successful, and, during more than one hour, messages were exchanged between Rouen and Havre. The Minister announced, on leaving Rouen, that the communication would be open to the public in about a fortnight. Since January 1 the first telephonic offices have been open in Paris, and it is probable that communication will soon be established between Paris and Rouen.

MR. LANT CARPENTER lectures on Sunday at the Sunday Lecture Society, on "The Life and Work of Sir William Siemens," illustrated by experiments, diagrams, and the oxy-hydrogen lanterns. Mr. Carpenter has, we understand, obtained some special materials, of which he will make use in his lecture.

REPORTS from Brussels state that the Spanish earthquake, or a similar simultaneous earthquake, was felt at the Royal Observatory there. The Observatory is stated not to be provided with special instruments for recording earthquakes, as these phenomena are so rare and slight in Belgium. It is said that on December 26 last, the day succeeding the first great shock of the Spanish earthquake, one of the astronomical clocks in the principal meteorological station in the Boulevard de l'Observatoire was stopped, and the other went irregularly. The officer charged with attending to them perceived that the pillars on which they rested had been displaced, and were no longer vertical. On the evening of the same day, M. Lagrange, when about to make some observations, noticed that the large telescope was also displaced. It appears from this that the undulations of the crust of the earth, which have had such disastrous effects in Spain, extended as far as Brussels, and although their effects were not generally appreciable in the latter city, yet they were noticeable in the case of delicate instruments, such as astronomical clocks. It would be interesting to have a precise, authentic statement on this subject, and also to learn whether similar effects were noticed anywhere else in Europe during the last week of the old year.

AT a recent meeting of the German Asiatic Society of Japan a paper was read by Dr. H. Muraoka of Tokio, on the magic mirror of Japan. It is generally supposed that its magical quality was discovered only recently; but it was, says Dr. Muraoka, known for a long time in Japan. Old ladies have